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LOOKING INTO THE FUTURE

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[Text] The first space flight by communist Yuriy Gagarin will remain forever a supreme human feat, the remarkable achievement of Soviet science and technology prepared by the whole course of our country's industrial and cultural building.

Man's first trip into space was made possible as a result of the implementation of a broad program of development of space technology in the Soviet Union. It was preceded by outstanding space experiments--the launching of the first artificial earth satellites, the first automatic interplanetary stations, and space vehicles with animals on board. A major role in the development and realization of this program and in the implementation of the latter stages of the conquest of space was played by Academicians S.P. Korolev and M.V. Keldysh and their companions in arms, under whose leadership work collectives of scientists, designers, workers, and technicians.

The decade of the era of manned space flights is crammed full of outstanding events in the research and conquest of the universe. These have been years of the rapid development of automatic means of space research, the launching of various types of artifical earth satellies and automatic stations designed to probe outer space, circumlunar flight, landing on the moon's surface, and the creation of artificial moon satellites. During these years automatic interplanetary stations have made voyages to Verus and Mars and have carried out the first research of outer space. Most valuable information has been obtained on the parameters of the atmosphere of the "morning star." For the first time a device created by man was landed on the surface of this mysterious planet, and information on the temperature at the place of landing was transmitted to earth. Manned space flights have become increasingly complicated, and improved spacecraft have been created. This decade has seen group flights of two or three spacecraft, the implementation of automatic and manual docking in space, and the creation of the first experimental orbital station with a crew of four men. The first space walk by cosmonaut A. Leonov was an important milestone. The landing of American astronauts on the moon's surface was a major event.

The lengthy 18-day flight by A. Nikolayev and V. Sevastyanov in Soyuz-9 provided important data on the processes of man's adaptation to the conditions of weightlessness and the subsequent readaptation to earth conditions.

Great significance is attached to the creation of the Luna-16 automatic station, which furnished earth with samples of lunar soil, and the self-propelled Lunokhod-1 vehicle, which is carrying out research and moving about the lunar surface under control from earth.

The first decade of the space age has seen many scientific discoveries which have substantially broadened our idea of space and of the moon and planets of the solar system. From experiments which one might call reconnaissance experiments, scientists have swithced to systematic research of outer space using space rocket technology.

In the initial period of the conquest of near-earth space the efforts of specialists were aimed at obtaining primary information on heavenly bodies and the development of various technical means for flights to our natural satellite and to outer space.

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Having accumulated the necessary experience and created powerful equipment, the leading space powers are going their own ways in further research.

In his speech at the meeting devoted to the reception for the heroic crews of Soyuz-6, Soyuz-7, and Soyuz-8 CPSU Central Committee General Secretary L.I. Brezhnev said: "Our country possesses a broad space program spread over many years. We are going our own way and are proceeding in a consistent and purposeful manner....

"Our path of the exploration of space is a path of the solution of fundamental tasks and basic problems of science and technology,...

"The Soviet Union sees space research as the great task of the cognition and practical assimilation of the forces and laws of nature in the interests of the man of labor and in the interests of peace on earth."

What are the main features of the next stage of the development of cosmonautics and the conquest of space? The main tasks of near-earth space research are still further study of the earth's upper atmosphere and magnetosphere, the sun-earth relationship, cosmic rays, extra-galactic sources of radiation, and other problems of interest to modern science.

The practical aspects of the use of space technology will play an ever increasing role. Space communications and television will begin to develop at rapid rates. Thanks to the system of television broadcasting via artificial earth satellites, and, in the near future, to the direct transmission of television programs from space to domestic antennas, opportunities will arise for the broader propagation of scientific, medical and sanitary, and agricultural knowledge. Space television will become accessible to the population of even the most remote corners of our planet and will play an important role in the development of education, raising qualifications, and raising the culture of peoples of developing countries.

With time, a worldwide system of space meteorology will also come into being with efficient means of processing information and the extensive use of computer technology. Such a system will enable increasingly accurate short-range and long-range weather forecasts to be made for every region and a service to be created for the speedy notification of cyclones, hurricanes, typhoons, tidal waves, and other formidable natural phenomena. In the more distant future at least the partial control of the weather will undoubtedly be realistic.

Important practical results will be provided by navigational satellites of the earth, which will enable coordinates to be determined and courses to be set more accurately by sea and air transport. It can be supposed that the achievements of cosmonautics in general will exert a considerable influence on the development of transport. Air-space aircraft and transport rockets will reduce the distances between continents to a minimum.

In the study of space, the moon, and other heavenly bodies of the solar system a leading role in our country now belongs to automatic machines. In space, as probably in no other sphere of human activity, they are blazing the trail for people. Automatic machines, whose potential is increasing every year, are the true scouts of the universe. In the next few years they will remain virtually the only instrument for the direct study of distant space and the planets. The economic aspect is also of considerable importance here: Automatic machines are many times less expensive than manned ones.

A worthy place is accorded manned flights in the Soviet space program. The intellectual, creative activity of a person who is on board a spaceship or orbital station and who is armed with data-measuring and automatic computer equipment enables an experiment to be set up more fully and in greater depth and more scientific information to be obtained. The cosmonaut will not only discover phenomena of nature which interest us, for example, the "eye of a typhoon" or the center of a forest fire, but he will also direct instruments toward them, follow the development of the phenomena under observation, and adopt the necessary decisions.

At the present stage of the Soviet space program circumterrestrial space, where such flights are particularly effective, serves as the main arena for manned flights.

The past decade of the space age was the epoch of man's breakthrough into space, of his walking in open space, and of the landing of the first expeditions on the surface of the moon. The second decade could be called the epoch of orbital stations and of man's planned research work under the conditions of space laboratories, a decade of the broad use of automatic stations. Space technology will move along a road of the consistent creation at first of simple and later of increasingly complex and large-scale orbital stations adapted for research and scientific and technical experiments. Obviously, quite universal research laboratories and specialized stations will make their appearance, such as astrophysical and radioastronomical extra-atmospheric orbital observatories, they can be fully automatic or visited periodically by personnel.

A most important direction in the development of space technology in the next decade will doubtlessly be the further improvement of automatic scouts of the universe. In the long term there will be the creation of a system of lunokhods and space rockets designed for delivering samples of rock and the results of other research from the lunar surface back to earth. Such apparatuses are to find the launching place of the rocket, approach the rocket, and load samples of rock and other experimental material in a container which can be returned to earth.

Autonomous systems for radio navigation and for plotting a course will enable the lunokhods to be driven great distances with high accuracy. They need to be supplied with medium-wave and long-wave radio transmitters which will enable communications to be maintained over distances considerably in excess of the range of direct radio visibility. In the future, in various regions of the moon, radio transmitters will be located which will ease lunar navigation and direction finding.

One can, for example, imagine the following picture. A program of movement is transmitted to the lunokhod, and the course and destination points are indicated. On the basis of these data the onboard navigation and control means insure the independent arrival of the machine at a set point. Receiving information about the nature of the locality and obstacles encountered from special radar or sounding apparatus and obtaining data about the position of the apparatus from the dead-reckoning instruments and the instruments for determining fixes, the onboard computer and control machinery calculates local changes in the course and gives the appropriate commands to the system which controls movement. Thus the lunokhod learns for itself how to avoid obstacles and insurmountable slopes without being thrown off the generally outlined course. It will be a truly cybernetic apparatus.

Such autonomous lunokhods are particularly necessary for journeys over the surface of the reverse, invisible side of the moon, when direct radio communications with the earth are practically impossible. To transmit information from on board a machine located on the surface of the reverse side of the natural satellite and for the periodic dispatch of commands and new assignments to the lunokhod, artificial moon satellites can be used. In certain instances the lunokhod will be able to return to the visible side of the moon. After this, it will have the opportunity to conduct direct transmissions of accumulated scientific information to the earth.

One of the most important achievements of the 20th century--the creation of powerful coherent sources of light (lasers)--opens broad prospects for cosmonautics too. Their significance for space communications and for the transmission of scientific information is difficult to overestimate. Lasers can be used for communications between space apparatuses, orbital stations, and scientific laboratories located on the moon and on the planets. Laser beams can be used for the transmission of scientific information, control commands, and so forth.

Space research is assuming a more and more complex nature. Under these conditions the development of cooperation between scientists and specialists of different countries is becoming urgent. We already have effective examples of cooperation in this sphere. In accordance with the cooperation program of the nine socialist countries, four satellites of the Intercosmos series and the geophysical rocket Vertikal-1 have already been launched, and cooperation with France and certain other countries is developing. In particular, joint research is being conducted into the magnetically linked points of the earth--Arkhangelsk Oblast and the Kergelen Islands in the Indian Ocean--and the opportunity has arisen for conducting experiments in laser detection of the moon with the aid of the French angle reflector which is installed on the Soviet lunokhod and so forth. Agreement has been reached on the development of cooperation between the USSR and the United States in certain directions of space research.

The decade of the epoch of space flights, in the course of which many step-by-step tasks of conquering space have been solved and important discoveries have been made, has brought an enormous amount of experimental material. Its analysis and the forecasting of the further development of cosmonautics permit us to outline specific ways for the study and development of space in the interests of science and of mankind's progress.